Holt Instrument Laboratories

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DESIGNERS & MANUFACTURERS OF ELECTRONIC INSTRUMENTATION

INSTRUCTION MANUAL
FOR
AUDIO VOLTAGE AMPLIFIER
AVA-30M

This manual to accompany Serial No._____

HOLT INSTRUMENT LABORATORIES
Oconto, Wisconsin

DECEMBER 1965

CLAIM FOR DAMAGE IN SHIPMENT:

The instrument should be tested as soon as it is received. If it fails to operate properly, or it is damaged in any way, a claim should be filed with the carrier. Also, notify Holt Instrument Laboratories or the local representative immediately. A full report of the damage should be obtained by the claim agent and this report should be forwarded to us. We will advise you of the disposition to be made of the equipment and arrange for repair or replacement. Include model number and serial number when referring to this instrument for any reason.

WARRANTY:

Holt Instrument Laboratories warrants each instrument manufactured by them to be free from defects in material and workmanship. Our liability under this warranty is limited to servicing or adjusting any instrument returned to the factory for that purpose and to replace any defective parts thereof. Electron tubes, fuses and batteries are specifically excluded from any liability. This warranty is effective for one year after delivery to the original purchaser when the instrument is returned, transportation charges prepaid, and when upon our examination it is to our satisfaction defective. If the fault has been caused by misuse or abnormal conditions of operation, repairs will be billed at cost. In this case an estimate will be submitted before the work is started.

If any fault develops, the following steps should be taken:

1. Notify either the factory or the area Holt representative, giveng full details of the difficulty, and include the model and serial numbers. Upon receipt of this information we will give you service data or shipping instructions.

2. On the receipt of shipping instructions, forward the instrument prepaid to the factory or the authorized repair station indicated in the instructions. If requested, an estimate of the charges will be made before the work begins if such work is not covered by warranty. All shipments of Holt Instrument Laboratories' equipment should be packed in a strong exterior container surrounded by two or three inches of shock absorbing material.

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SECTION I
INTRODUCTION

1.1 General Description.

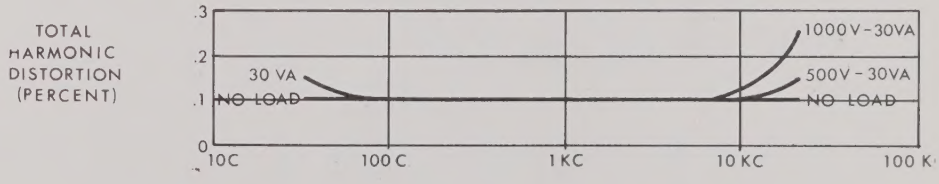
The Model AVA-30M Amplifier is designed for general laboratory use. When used with a laboratory audio oscillator, it provides output voltages up to 1000 volts at 30 volt-amps of power with very low distortion over the audio range of frequencies from 35 to 20,000 cps. The amplifier output may be isolated from ground if desired, thereby eliminating instrument ground loops in some applications.

1.2 Specifications.

OUTPUT:

Voltage Range:	Continuously variable from 0 to 1000 volts, with selected full output voltages of 1, 3, 5, 10, 30, 50, 100, 300, 500 and 1000 volts.
Frequency Range:	35 cps to 20 KC.
Power:	30 voltamperes or maximum range current, whichever is less.
Current:	3 amperes on 1, 3, 5 and 10 volt ranges. 300 milliamperes on 30, 50 and 100 volt ranges. 100 milliamperes on 300 volt range. 30 milliamperes on 500 and 1000 volt ranges.

Distortion:



Hum and Noise:	75 db below full output voltage.
Impedance:	.05 ohms/volt (full output voltage) maximum.
Stability:	±.01% short term, random.
Line Regulation:	±0.1% for slow line changes.

INPUT:

Sensitivity:	1 volt RMS for full output voltage.
Impedance:	100,000 ohms.
Power Source:	105-125 / 210-250 volts; 50/60 cycles, 230 watts.

MECHANICAL:

Dimensions:	19" W x 7" H x 13" D. Standard Rack Mount.
Weight:	65 lbs. Net. 90 lbs. Shipping.

SECTION 2

OPERATING INSTRUCTIONS

2.1 Preparation for Use.

The AVA-30M Amplifier is cooled by forced-air ventilation. The instrument must therefore be placed so that the air holes in the top and bottom rear covers are not blocked.

The instrument is designed for operation on either 115 or 230 V lines. Check the transformer connections to be sure they correspond to those indicated in Figure 1 for the particular line voltage to be used. The terminal strip is located on the inside of the frame, adjacent to the line cord. Also, check the fuses on the front panel for the proper rating.

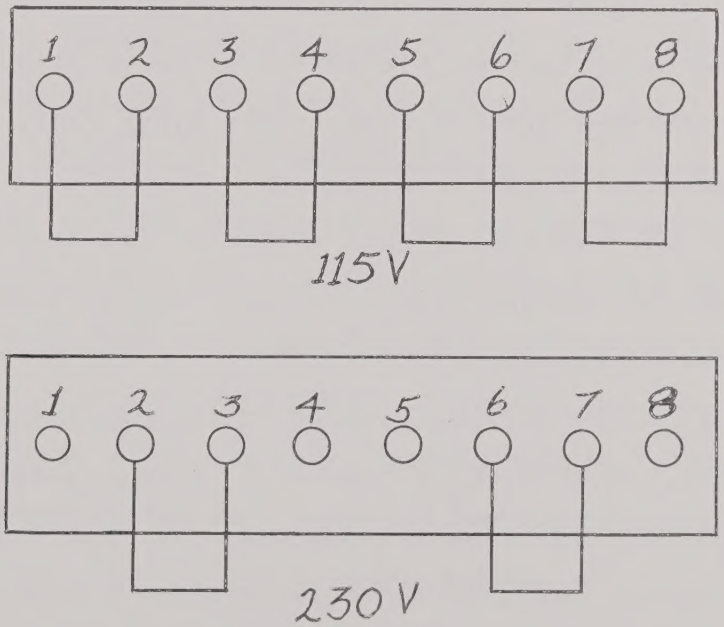


Figure 1

2.2 Controls and Connectors.

INPUT: The terminals on the left side of the front panel connect the audio signal to the power amplifier. The common input

terminal is connected to the chassis. The signal is applied through a 0.5 mfd capacitor to the input level control.

INPUT LEVEL: This control, located above the input terminals, is a 100 KΩ, potentiometer which is used to adjust the amount of input signal applied to the preamplifier input. Varying the input signal causes the output voltage to vary in direct proportion.

FIL. ON: This toggle switch is located to the left of the front panel center. Turning the switch up to ON applies line power through the .5 A Slo-Blo fuse to the FIL. lamp, and to the filament transformer primary. It also applies power through the .5 ampere Slo-Blo fuse (located inside rear cover) to the ventilation fan and to one side of the plate power switch.

PLATE ON: This toggle switch is located to the right of the front panel center. Turning the switch up to ON applies line power through the 3 A Slo-Blo fuse to the PLATE lamp, and to the plate power transformer.

OUTPUT VOLTS: This switch, in the center of the front panel, selects any of ten maximum output voltage levels by selecting the output transformer taps.

500-1000 VOLTS: This switch, located in the top right side of the front panel, selects the proper high voltage output transformer above 300 volts. The AVA-30M uses two high voltage output transformers designed for optimum operation over the ranges of 35 - 2000 cps and 2000 - 20,000 cps. This switch position can be neglected when the OUTPUT VOLTS switch is at 300 V or below.

OUTPUT: The terminals on the right side of the front panel

connect the output transformer secondary voltage to the external load. The lower black terminal is connected to the chassis. The left black output terminal is connected to the output transformer secondary common, and is completely isolated from any other common.

To reference the output to ground at the output terminals connect the ground link, which is provided with the unit, between the two black output terminals.

2.3 Operation.

To place the amplifier in operation, connect a low distortion laboratory audio oscillator to the input terminals. Turn on the oscillator and set its output for approximately 1.0 volts RMS.

Turn the AVA-30M FIL. switch ON. During warmup, select the desired output voltage with the OUTPUT VOLTS switch. The amplifier should not be operated at a level below that of the next lower voltage switch setting for operation within the AVA-30M specifications. When operating in the 500 or 1000 volt positions BE SURE the 500-1000 VOLTS switch is in the proper frequency position, to prevent operation outside of specifications.

A delay of at least 30 seconds should follow actuation of the filament switch to allow tube warmup before the DC voltages are applied with the PLATE power switch.

With the INPUT LEVEL control set fully counter-clockwise, turn the PLATE switch ON. Monitor the output with a voltmeter while increasing the input level.

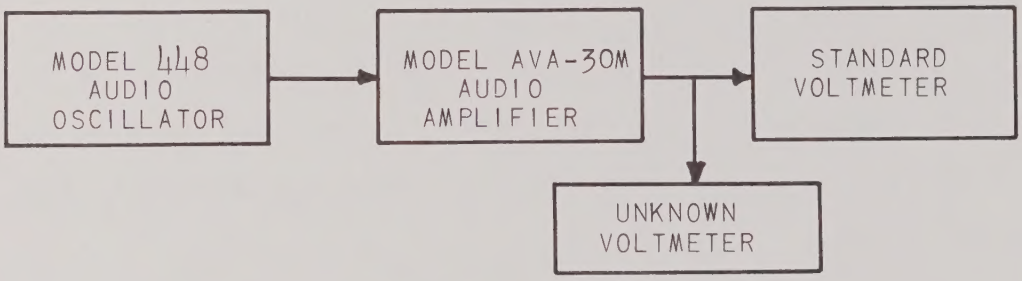
Do not operate the amplifier with the output above the selected voltage setting, or operation outside of specifications will result.

Use caution also that the amplifier is NOT loaded more than 3 amperes or 30 volt-amps, whichever is less, to prevent operation outside of specifications.

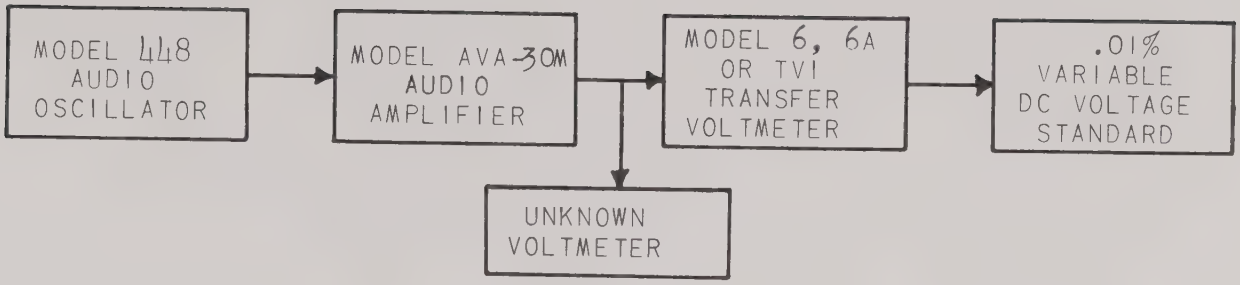
2.4 Applications.

The Model AVA-30M is designed primarily as a source of low distortion, highly stable AC signals to be used in the calibration of AC voltage measuring or recording instrumentation.

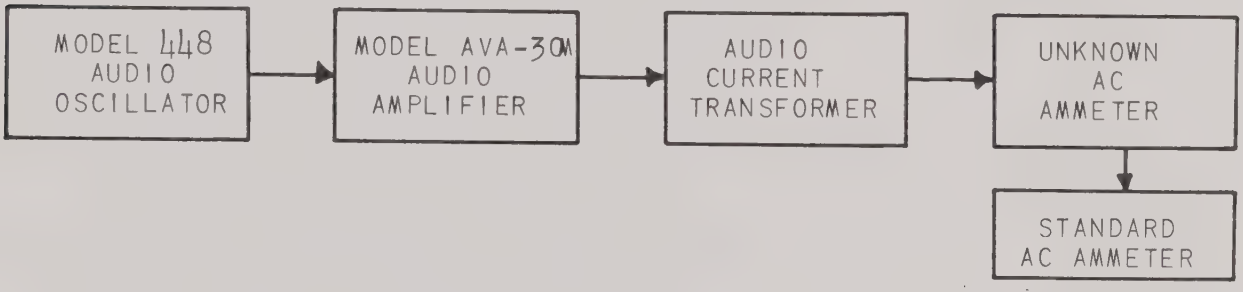
AC Voltage Measurement



The output of a stable Audio Oscillator (35 to 20,000 cps) drives the Model AVA-30M. The AVA-30M output voltage (0 - 1000 volts) is applied simultaneously to a standard voltmeter and the unknown voltmeter under test. The indication on the unknown instrument is compared to the indication on the standard for calibration. Since the output of the AVA-30M is continuously variable any desired output may be established. The basic accuracy of the output at any setting is a function of the accuracy and resolution of the standard voltmeter. For N.B.S. traceable calibration to the highest accuracy, Holt recommends the Model 6, 6A or TVI Thermal Transfer Voltmeters as the standard voltmeter. (See below.)


MODEL 448 AUDIO OSCILLATOR
MODEL AVA-30M AUDIO AMPLIFIER
MODEL 6, 6A OR TVI TRANSFER VOLTMETER
.01% VARIABLE DC VOLTAGE STANDARD
UNKNOWN VOLTMETER

AC Current Measurement



By driving an AC current transformer with the AVA-30M output voltage, output currents to 10 amperes are available with good stability and purity. The application of this current through a standard ammeter and an unknown ammeter in series permits AC ammeter calibration with only small additional investment. The amplitude controls on the AVA-30M, though not calibrated in terms of the resulting current, provide fine control of that current for any desired level. Consult Holt for the details of the current measurement capability employing the AVA-30M. For N.B.S. traceable AC current calibration the standard ammeter should be the Holt Model HCS-1 Audio Current Shunts. They permit AC current standardization to .02% over the audio frequency range to 20 amperes.

Miscellaneous Applications

The power, voltage and frequency capability of the AVA-30M qualify it for application to a variety of tasks beyond those described above. The specifications completely delineate the

performance in each of these areas. Consult the technical specifications of Holt Instrument Laboratories for information concerning any un-related application.

SECTION 3

THEORY OF OPERATION

3.1 Overall Design.

The AVA-30M consists of two basic blocks: the power amplifier, and the power supply which furnishes all the AC and DC power necessary for the power amplifier.

3.2 Power Amplifier.

This section is a high feedback, linear amplifier designed to operate with very low distortion at the specified loads, frequencies and voltages. It consists of a triode preamplifier, V3B, followed by a grounded grid phase inverter, V4. V5 is a push-pull amplifier stage with plate positive feedback supplied from the output stage. V6 is a push-pull cathode follower driver stage, followed by the output stage which is composed of four 5881's, V7, V8, V9 and V10, operation in push-pull parallel. The output stage is operated in Class AB-1. with current flowing in each half during approximately 300 degrees of the cycle. The output transformer, T3, primary is divided into matched plate and cathode windings so that the stage is DC self-balancing.

The output transformer secondary is composed of two windings. One winding supplies a voltage which is fed back degeneratively to the cathode of the first stage preamplifier. The negative feedback in this loop is approximately 22 db.

The other secondary winding is tapped to provide the output voltage increments up to 300 volts. Above 300 volts and below 2 KC the output transformer drives a high voltage transformer, T5, to obtain output voltages up to 1000 volts with low distortion down to 35 cps.

Above 300 volts and above 2 KC the output transformer

drives the toroid wound high voltage transformer, T4, to obtain output voltages up to 1000 volts with low distortion up to 20 KC.

3.3 Power Supply.

The power supply voltages are derived from the plate and filament transformers.

Filament transformer, T2, has three 6.3 volt output windings. Two windings supply power to the 5881's in the amplifier output stage and the other winding supplies all other filament requirements. Both the positive and negative DC supplies are driven from the plate transformer, T1.

The positive DC supply is composed of a full wave rectifier and a capacitor input, pi network filter which provides approximately +420 volts to the amplifier output stage and the two push-pull stages and to the two positive DC supply voltage regulators.

The +250 volt regulator is a shunt regulator stage, V1, which supplies the plate potential for the amplifier phase inverter stage.

The +140 volt regulator is also a shunt regulator stage, V3A, which provides a very low-ripple plate voltage for the first stage preamplifier.

The negative DC supply is a half wave rectifier with an RC filter which supplies -250 volts for bias potential in the amplifier cathode follower and output stages. This supply also energizes a -105 volt regulator stage, V2, which provides a stable reference voltage for the +250 and +140 volt regulators.

SECTION 4

RECALIBRATION

4.1 Recommended Test Equipment.

When recalibrating the AVA-30M amplifier at periodic recalibration intervals or after repairs have been made, the following test instruments should be used, or other instruments of similar quality:

Audio Oscillator	Holt Model 448
Distortion Analyzer	Hewlett Packard Model 330B

4.2 Distortion Measurement.

With the AVA-30M operating at the 10 volt output level, read the total output distortion when the oscillator is set at frequencies of 35 cps, 1 KC, 10 KC and 20 KC. The total distortion when the amplifier is unloaded should not exceed the oscillator distortion plus .1%. If necessary, adjust the Balance Control, R11, located under the top dust cover for minimum distortion.

SECTION 5
SERVICING

5.1 Preliminary.

Prior to servicing the unit, the fan should be turned off by removing the fan fuse, F3, for the safety of the maintenance personnel.

Should it be necessary to order a part from the factory, always include the unit model and serial numbers, the part description and Holt part number. The serial number shown on the frontispiece of this manual must match the instrument serial number if the parts are to be ordered from the manual.

5.2 Feedback Level.

To measure the feedback level use the following procedure: With the INPUT LEVEL control fully counter-clockwise and the PLATE switch "OFF", disconnect the shielded feedback lead from one end of C4 and R5 at the terminal next to the Balance Control, R11, located under the top dust cover. Set the OUTPUT VOLTS switch to 10 volts and, with 1000 cps signal applied to the input, slowly increase the INPUT LEVEL until an output of 10 volts is obtained.

CAUTION: The open-loop amplifier gain is very high and only a fraction of the normal input will provide full output.

Reconnect the feedback lead and read the difference in output levels in decibels. This new level should be at least 22 db below the previous level.

5.3 Hum Level.

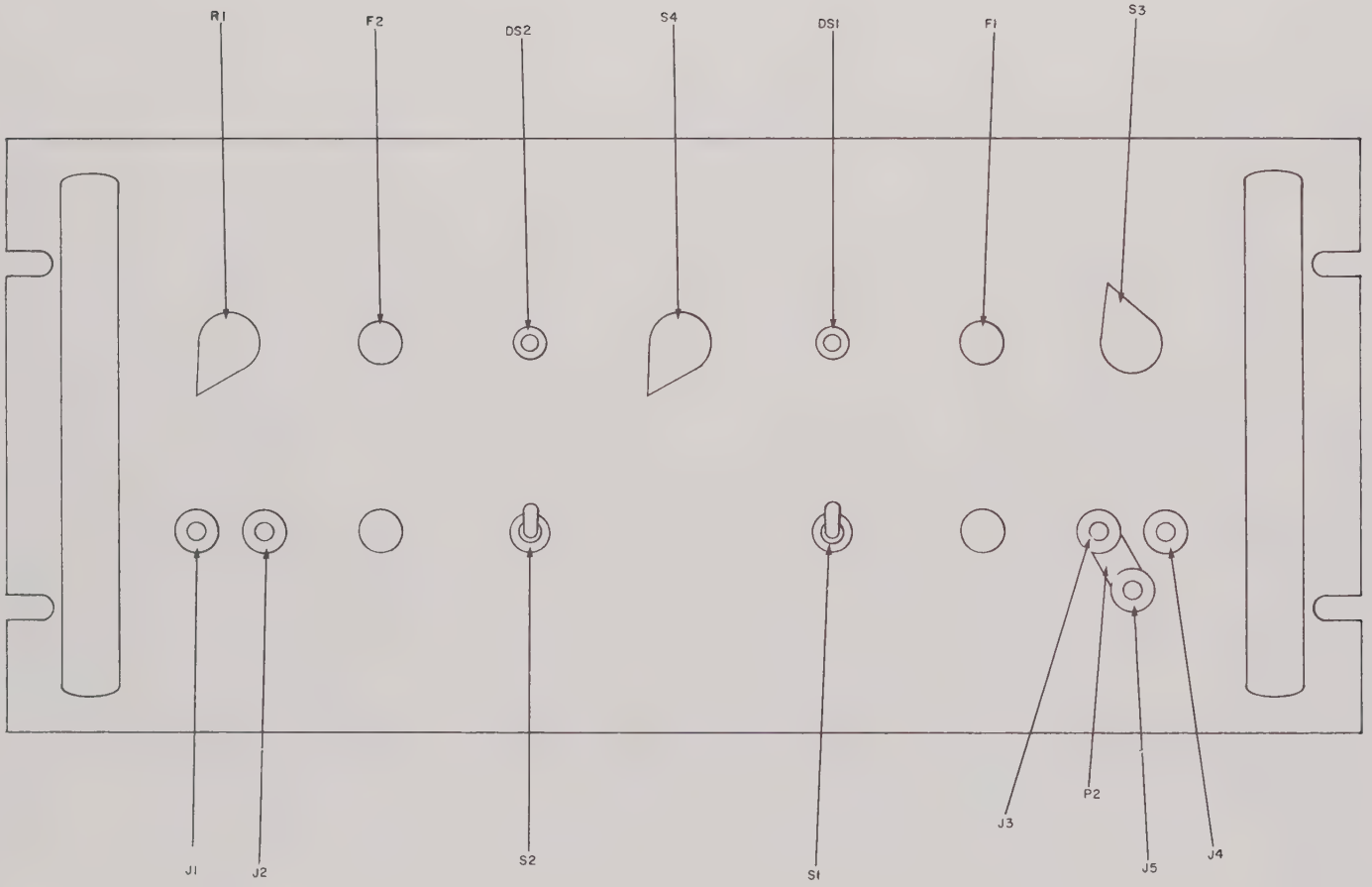
With the OUTPUT VOLTS switch in the 300 volt position, set the INPUT LEVEL control fully counter-clockwise. Measure the output voltage level, which is all hum and noise. This

level should be at least 75 db below the nominal 300 volt level.

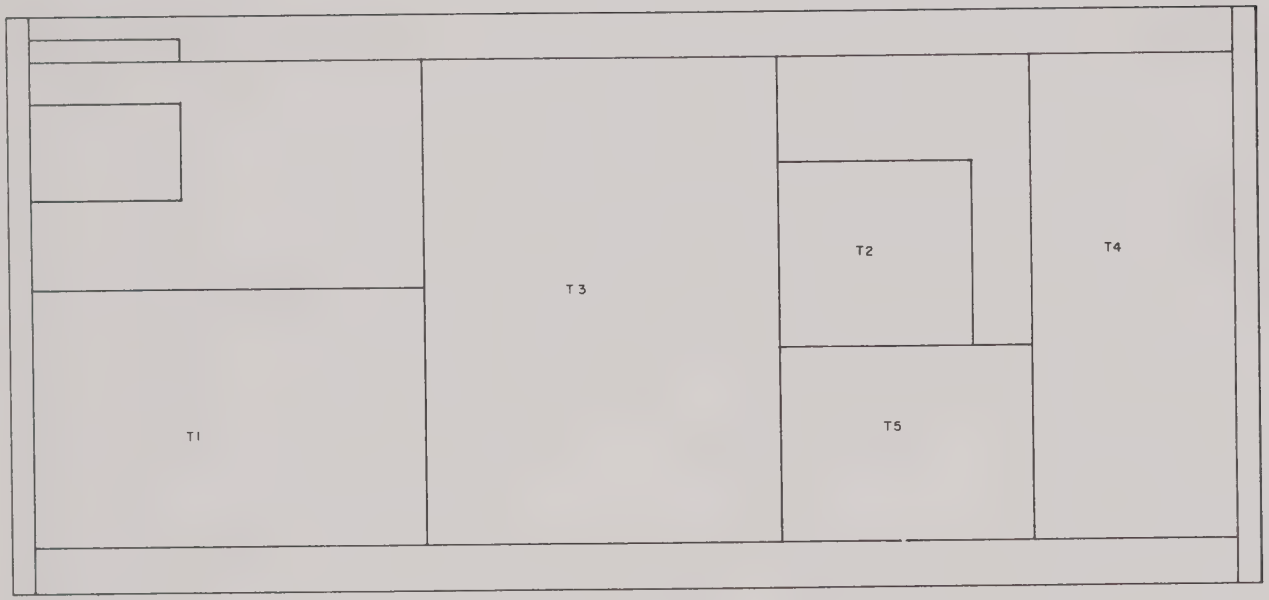
5.4 Voltage Measurement.

Unless otherwise specified, all of the DC voltage readings were taken with a DC vacuum-tube voltmeter having an input resistance of 11 megohms. The AC peak-to-peak voltage readings were obtained with an oscilloscope having an input resistance of 1 megohm.

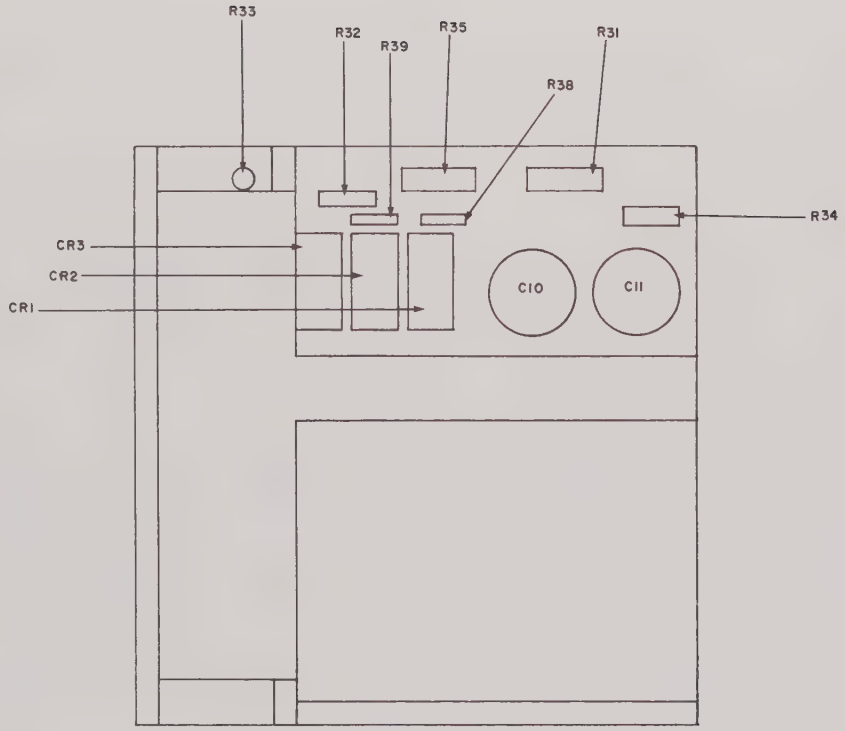
There will be considerable variation between instruments because of normal manufacturing tolerances and vacuum-tube characteristics. Therefore, the significance of any discrepancies observed should be determined by referring to the circuit diagram. The tolerance for voltage readings is $\pm$ 10% unless otherwise indicated. All readings are in volts measured with respect to ground unless otherwise specified.



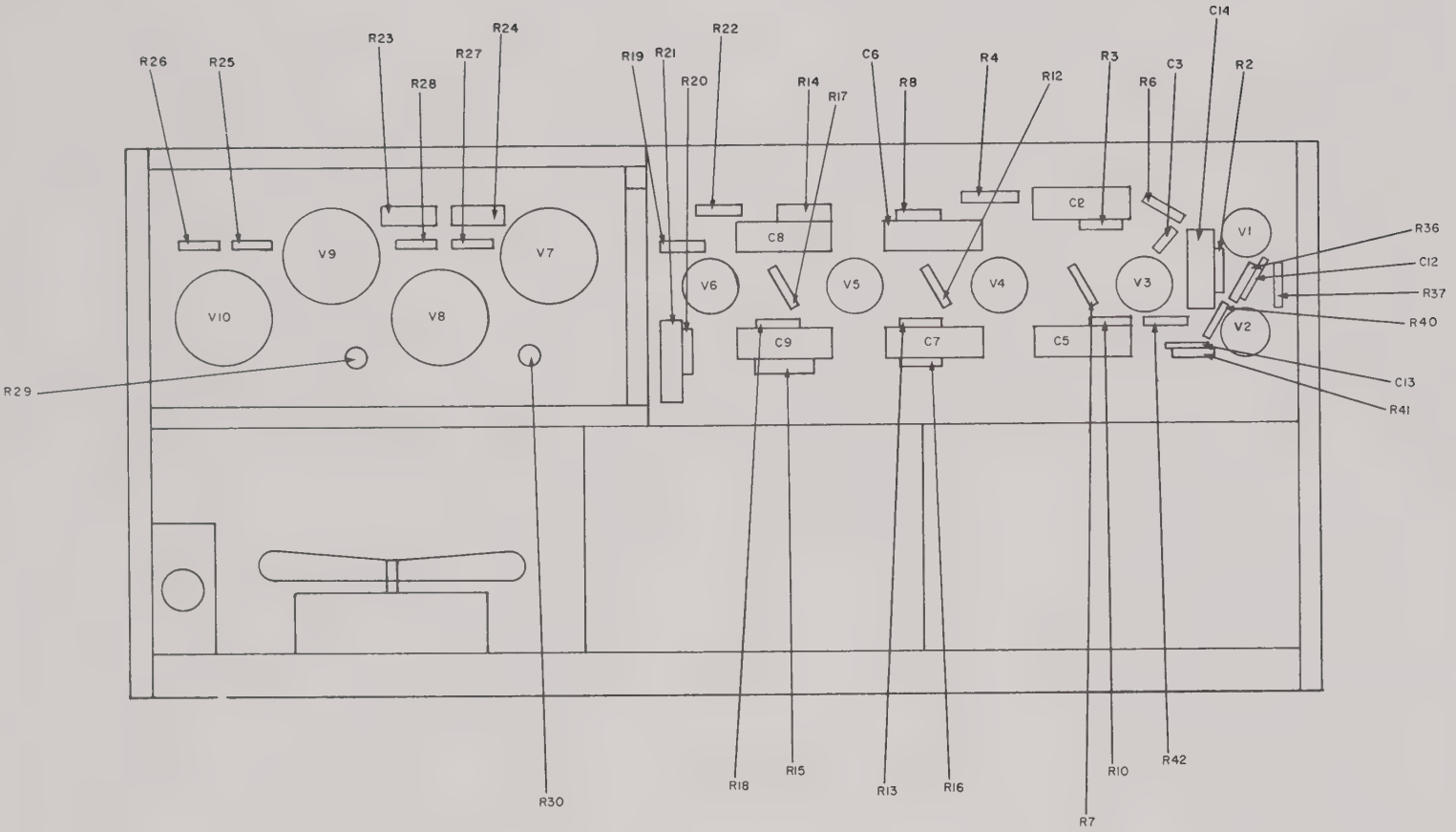
FRONT VIEW



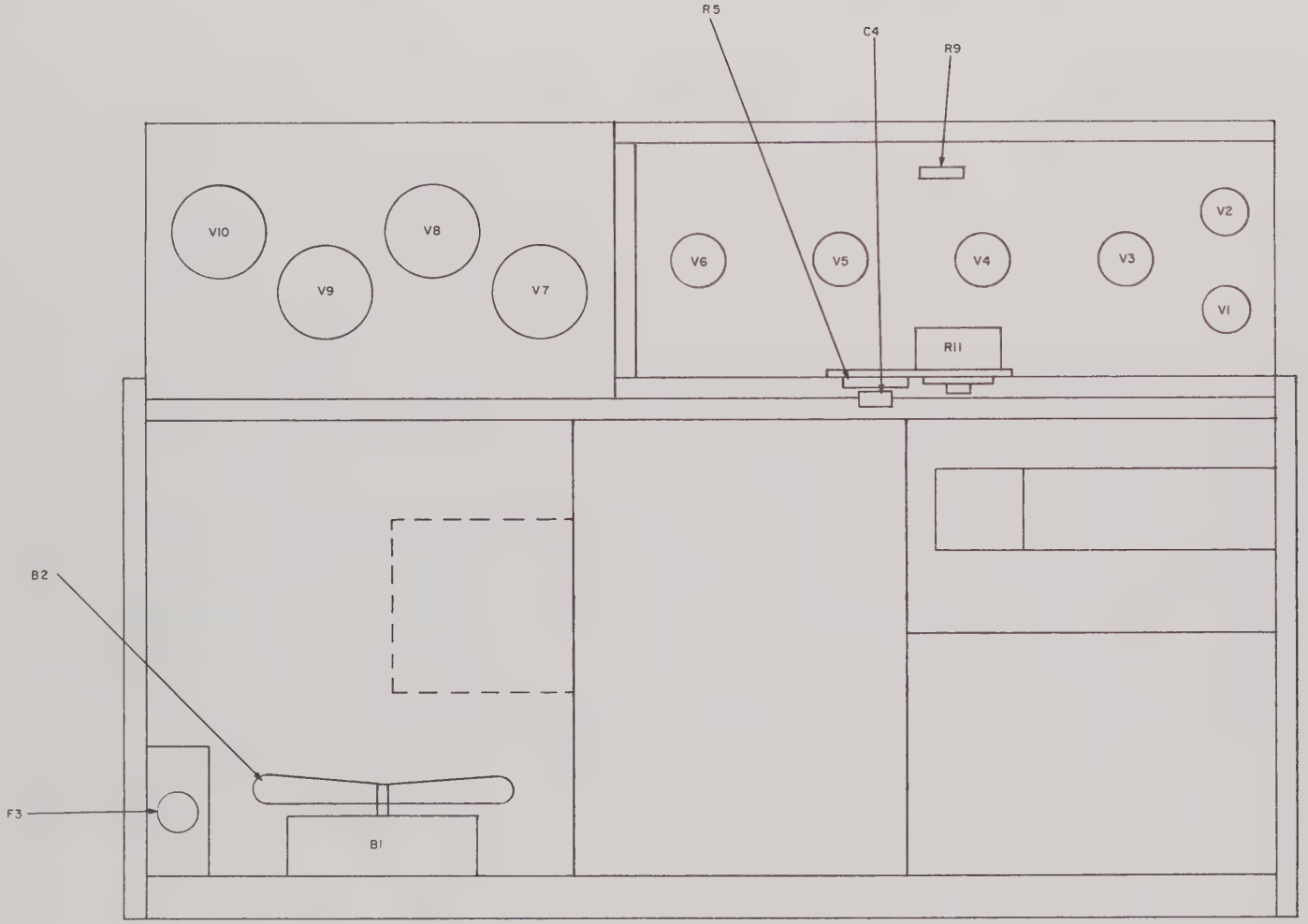
FRONT VIEW WITH FRONT PANEL REMOVED



LEFT SIDE OF UNIT VIEWED FROM INSIDE


R26
R25
R23
R28
R27
R24
R19
R21
R20
R22
R14
R17
C6
R8
R4
R12
R3
R6
C3
C14
R2
R36
C12
R37
R40
C13
R41
R29
R30
R18
R15
R13
R16
R7
R10
R42
V9
V7
V10
V8
V6
V5
V4
V3
V2
V1
C8
C9
C7
C5
C2

REAR VIEW



REAR VIEW WITH AMPLIFIER BOARD TILTED UP

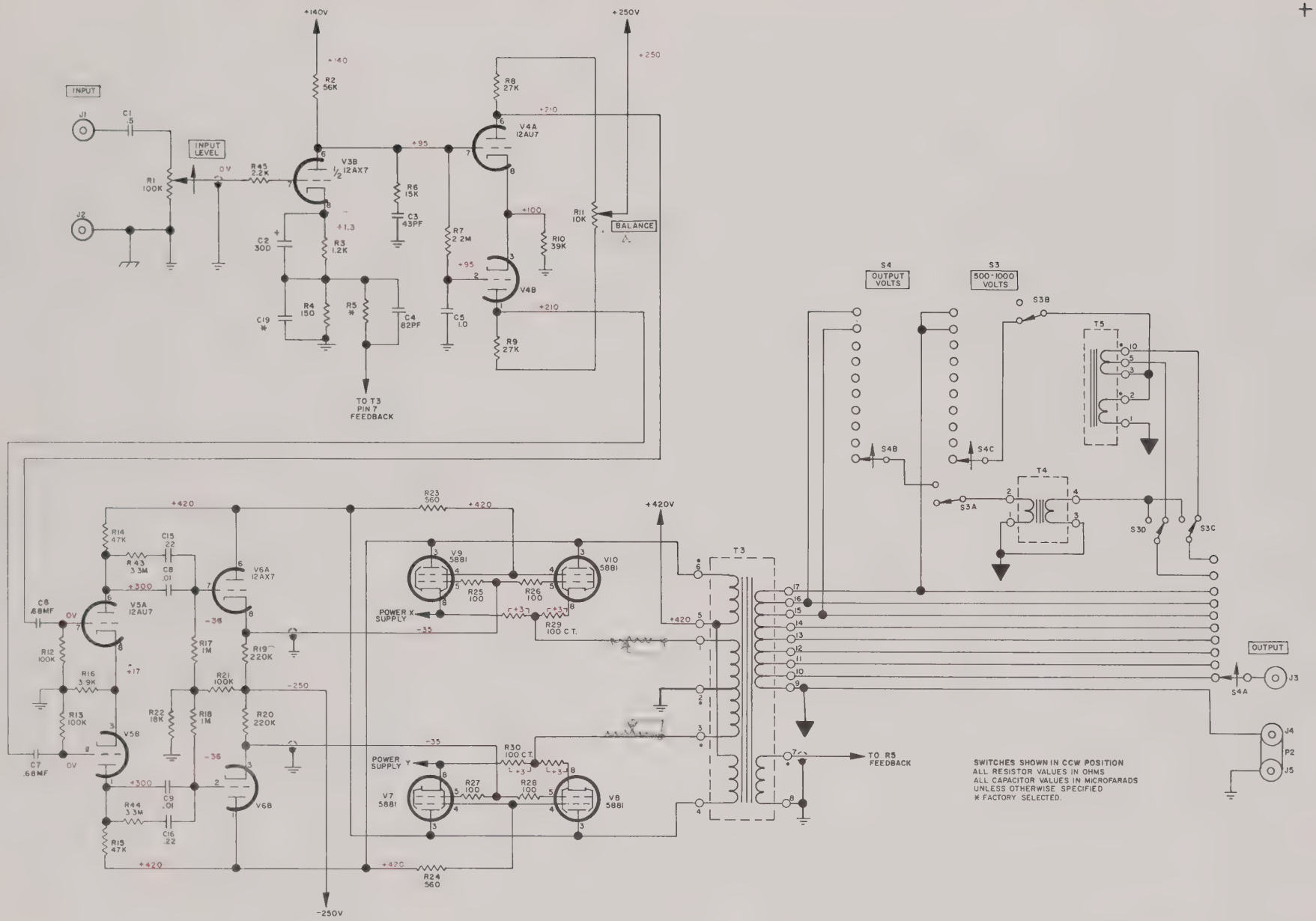
REPLACEABLE PARTS LIST

Ckt. Ref.	Description	Holt Part Number
B1	Motor, 1 Phase, 115 VAC, 60 cps	8702-003
B2	Blade, Fan	8703-002
C1	Capacitor, Fixed, Metallized Paper 200 V, .5 MFD, ± 20%	0902-028
C2	Capacitor, Fixed, Electrolytic 3 V, 300 MFD, -10% +75%	0905-002
C3	Capacitor, Fixed, Mica 500 V, 43 pf, ± 5%	0907-038
C4	Capacitor, Fixed, Mica 500 V, 82 pf, ± 5%	0907-047
C5	Capacitor, Fixed, Metallized Mylar 200 V, 1 MFD	0904-004
C6 & C7	Capacitor, Fixed, Metallized Paper 100 V, 1 MFD, ± 20%	0902-002
C8 & C9	Capacitor, Fixed, Mylar 600 V, .01 MFD, ± 10%	0903-040
C10A,B,C	Capacitor, Three-Section, Electrolytic 450 V, 80-40-20 MFD, -10% +50%	0905-038
C11A,B	Capacitor, Dual-Section, Electrolytic 450 V, 40-40 MFD, -10% +50%	0905-033
C12 & C13	Capacitor, Fixed, Ceramic 600 V, .01 MFD, GMV	0906-001
C14	Capacitor, Fixed, Metallized Paper 400 V, .1 MFD, ± 20%	0902-023
C15 & C16	Capacitor, Fixed, Metallized Paper 400 V, .22 MFD, ± 20%	0902-022
C17	Capacitor, Fixed, Ceramic 600 V, .01 MFD, GMV	0906-001
C18	Capacitor, Fixed, Electrolytic 450 V, 40 MFD, ±10%	0905-029
C19	Capacitor, Fixed, Mylar 600 V, .006 MFD, ± 10%	0903-048
CR1 thru CR3	Diode, Silicon, 2000 PIV, 750 MA	0301-010

Ckt. Ref.	Description	Holt Part Number
DS1 & DS2	Lamp, 115 V	0502-005
F1	Fuse, Slo-Blo, 3 Amp, 250 V	1002-008
F2 & F3	Fuse, Slo-Blo, 1/2 Amp, 250 V	1002-002
J1	Binding Post, Red	1803-018
J2	Binding Post, Black	1803-017
J3	Binding Post, Red	1803-018
J4 & J5	Binding Post, Black	1803-017
P1	Plug, 3 Pin Line Cord	1702-027
P2	Shorting Link	1705-018
R1	Resistor, Variable, Composition 2 Watt, 100 KΩ, ± 10%	0806-008
R2	Resistor, Fixed, Composition 1/2 Watt, 56 KΩ, ± 10%	0801-064
R3	Resistor, Fixed, Composition 1/2 Watt, 1.2 KΩ, ± 10%	0801-045
R4	Resistor, Fixed, Metal Film 1/2 Watt, 150 Ω, ± 1%	0804-094
R5	Resistor, Fixed, Metal Film 1/2 Watt, 4990 Ω, ± 1%	0804-135
R6	Resistor, Fixed, Metal Film 1/2 Watt, 15 KΩ, ± 1%	0804-146
R7	Resistor, Fixed, Composition 1/2 Watt, 2.2 MΩ, ± 10%	0801-081
R8 & R9	Resistor, Fixed, Composition 1/2 Watt, 27 KΩ, ± 10%	0801-060
R10	Resistor, Fixed, Composition 1/2 Watt, 39 KΩ, ± 10%	0801-062
R11	Resistor, Variable, Composition 2 Watt, 10 KΩ, ± 10%	0806-007
R12 & R13	Resistor, Fixed, Composition Watt, 1 KΩ, ± 10%	0801-067
R14 & R15	Resistor, Fixed, Composition 1 Watt, 47 KΩ, ± 10%	0801-144

Ckt. Ref.	Description	Holt Part Number
R16	Resistor, Fixed, Composition 1 Watt, 390 KΩ, ± 10%	0801-051
R17 & R18	Resistor, Fixed, Composition 1/2 Watt, 1 MΩ, ± 5%	0801-019
R19 & R20	Resistor, Fixed, Composition 1/2 Watt, 220 KΩ, ± 10%	0801-071
R21	Resistor, Fixed, Composition 2 Watt, 100 KΩ, ± 10%	0801-185
R22	Resistor, Fixed, Composition 1/2 Watt, 18 KΩ, ± 5%	0801-006
R23 & R24	Resistor, Fixed, Composition 2 Watt, 560 Ω, ± 10%	0801-169
R25 thru R28	Resistor, Fixed, Composition 1/2 Watt, 100 Ω, ± 10%	0801-032
R29 & R30	Resistor, Fixed, Wire Wound 10 Watt, 100 Ω, CT, ± 10%	0805-045
R31	Resistor, Fixed, Wire Wound 8 Watt, 10 Ω, ± 5%	0805-004
R32	Resistor, Fixed, Composition 2 Watt, 6.8 KΩ, ± 10%	0801-178
R33	Resistor, Fixed, Wire Wound 20 Watt, 100 Ω, ± 5%	0805-050
R34	Resistor, Fixed, Composition 2 Watt, 33 KΩ, ± 10%	0801-181
R35	Resistor, Fixed, Wire Wound 8 Watt, 15 KΩ, ± 5%	0805-023
R36	Resistor, Fixed, Composition 1/2 Watt, 2.7 MΩ, ± 10%	0801-082
R37	Resistor, Fixed, Composition 1/2 Watt, 1 MΩ, ± 5%	0801-019
R38 & R39	Resistor, Fixed, Composition 1 Watt, 82 KΩ, ± 10%	0801-147
R40	Resistor, Fixed, Composition 1/2 Watt, 300 KΩ, ± 5%	0801-014
R41	Resistor, Fixed, Composition 1/2 Watt, 1 MΩ, ± 5%	0801-019

Ckt. Ref.	Description	Holt Part Number
R42	Resistor, Fixed, Composition 1/2 Watt, 470 KΩ, ± 5%	0801-017
R43 & R44	Resistor, Fixed, Composition 1/2 Watt, 3.3 MΩ, ± 10%	0801-083
R45	Resistor, Fixed, Composition 1/2 Watt, 2.2 KΩ, ± 10%	0801-048
S1 & S2	Switch, Toggle, SPST	1103-001
S3	Switch, Rotary	1101-027
S4	Switch, Rotary	1101-028
T1	Transformer, Plate Supply	1601-013
T2	Transformer, Filament Supply	1602-010
T3	Transformer, Amplifier Output	52415
T4	Transformer, High Voltage, High Frequency	52418
T5	Transformer, High Voltage, Low Frequency	1603-002
V1	Electron Tube, 6AB4	0101-009
V2	Electron Tube, 0B2	0101-001
V3A, V3B	Electron Tube, 12AX7	0102-001
V4	Electron Tube, 12AU7	0102-003
V5	Electron Tube, 12AU7	0102-003
V6	Electron Tube, 12AX7	0102-001
V7 thru V10	Electron Tube, 5881	0103-002



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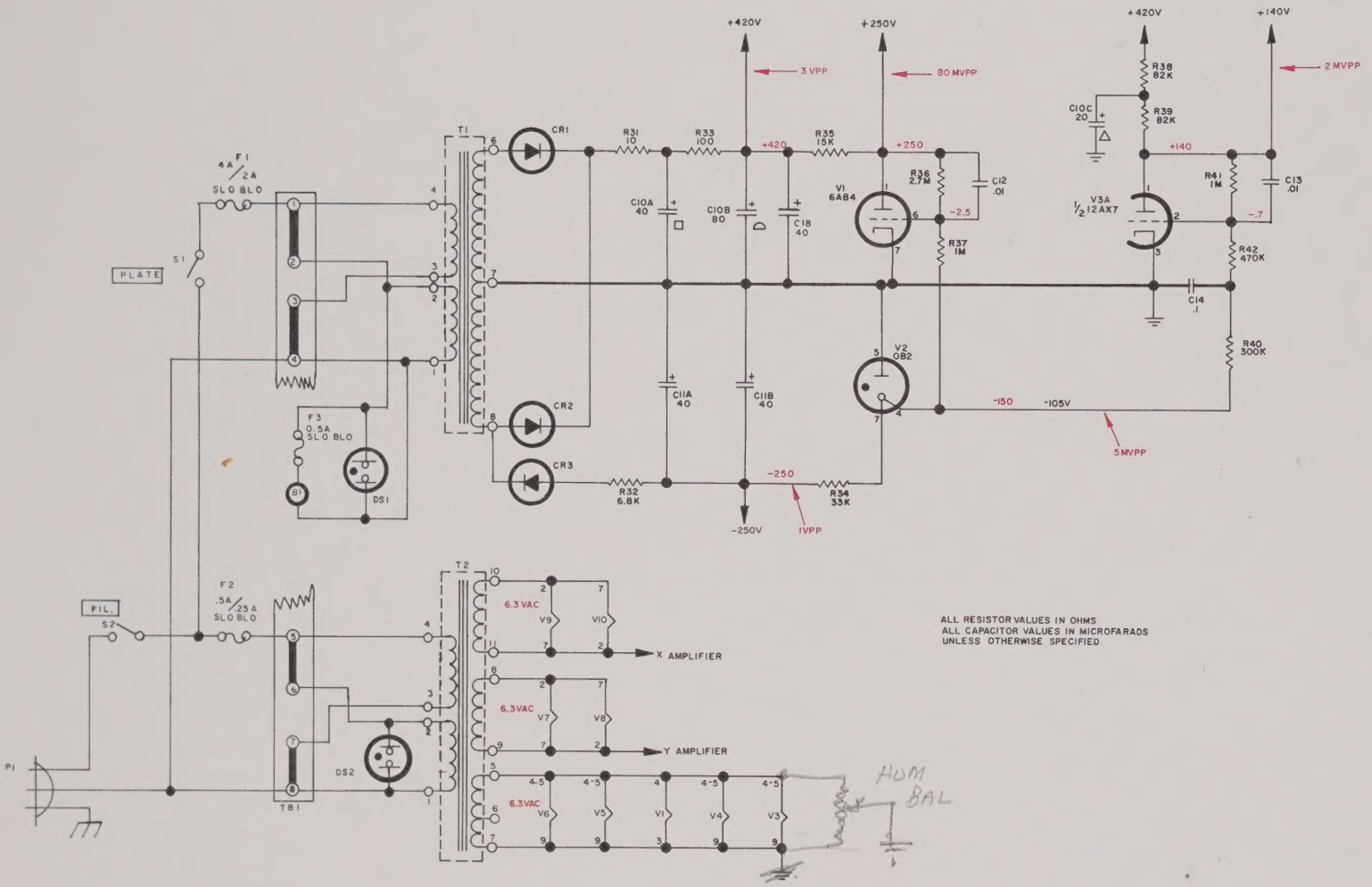
TITLE: AMPLIFIER

SCALE	DATE	APPD.	MODEL	DATE	ENG.
	ERS	PHR	AVA-30	12-7-62	



ALL RESISTOR VALUES IN OHMS
ALL CAPACITOR VALUES IN MICROFARADS
UNLESS OTHERWISE SPECIFIED

TOL. UNLESS NOTED FRACT. DEC. ∠	HOLT INSTRUMENT LABORATORIES OCONTO • WISCONSIN					
	TITLE POWER SUPPLY					
SCALE	DEPT. ERS	APPD. PHR	MODEL AVA-30M	DATE 12-7-62	DWG.	
MAT'L.		FIN.				